

Electric arc flash management

Background

Electric arc flash accidents regularly cause injuries and fatalities to Australian electrical workers on the mainland.

On 4 November 2019, an electrician received severe electrical burns to his upper torso following an electrical arc flash while working at a Mirrabooka construction site, in Perth. The accident is currently being investigated by Worksafe and Energy Safety WA.

Those in Western Australia may recall the Morley Galleria shopping centre arc flash explosion of 2015. While electricians were conducting maintenance on an 11 kV fuse switch an arc flash occurred killing two persons and severely injuring two others.

NOPSEMA has received three arc flash related notifications from offshore facilities in the last two years. Fortunately no injuries were sustained.

NOPSEMA routinely receives notifications where incorrect electrical isolations have resulted in the electrical equipment remaining energised. This has the potential to expose offshore personnel to arc flash risk.

Arc flash hazard

An electrical fault can cause arc flash. Arc flash can result in explosive energy caused from vaporising metal as it transitions from a solid to plasma. Plasma can be ejected by the arc which can exceed 5000 degrees Celsius. Deafening sound waves (greater than 140 decibels) and pressure waves (greater than 13.7 MPa) can result. Material and molten metals can be expelled from the arc at speeds exceeding 1120 km/hr.

Arc flash can ignite non-arc rated clothing and non-arc rated PPE, which has resulted in serious burn injuries and fatalities. The explosive pressures can rupture eardrums and collapse lungs.



Electrical arc flash



Australian arc flash management guidance

In March 2019, the Australian Energy Council (AEC) published its *Electrical Arc Flash Hazard Management Guideline* to increase awareness of arc flash hazards to eliminate or minimise the risk of injury.

This formative consolidated guideline incorporates collective electric arc flash hazard knowledge and experience which is presented in an easy-to-read guideline. The guideline describes the hierarchy of control that can be applied to arc flash management. It also identifies a range of typical electrical activities, such as proving the electrical equipment is de-energised, IR thermography, racking (panel open) and racking (panels closed) etc. and identifies typical arc flash controls.

The guideline is free to download in [Additional resources](#).

Arc flash management on offshore facilities

Almost every Australian offshore facility has electrical systems that have the potential to result in an arc flash sufficient to lead to injuries.

NOPSEMA inspectors have observed that most facility operators have, or are in process of, improving arc flash management controls to reduce risks to their workforce. For example, a number of inspections have found that:

- arc flash engineering studies have been conducted (typically to IEEE 1584)
- engineering modifications have been implemented, where practicable
- electrical procedures have been revised for arc flash
- switchboards and electrical equipment have been marked with arc flash labelling
- electrical personnel have received arc flash and electrical rescue training
- arc flash PPE is made readily available.

However, some inspections have found that certain operators have yet to effectively address arc flash hazard management.

Following the hierarchy of controls for arc flash management, elimination of the electrical hazard (de-energised) is the most effective arc flash risk control. De-energised (and earthed if high voltage) equipment reduces arc flash risk. However, the process to isolate, prove de-energised and earth conductors carries a high risk of inadvertent live contact and has arc flash risk.

Australian Standards provide clear warnings that 'all electrical conductors and parts, including neutral and earthing conductors, shall be treated as energised until proven de-energised'. The task of 'proving de-energised' or 'testing for dead' should be considered to as 'live' working, where no fixed barrier separates the person or their tools from conductors to be tested as de-energised.

Electrical equipment can be engineered to reduce arc flash energy. *Australian Standard 2067:2016* lists engineering measures to reduce arc flash risk, while the AEC *Electrical Arc Flash Hazard Management Guideline* describes engineering controls for both new and older plant designs.

In older offshore facilities where implementing a full range of engineering modifications to reduce arc flash risk levels are not feasible, more reliance on robust procedural controls and arc flash PPE may need to be practiced to reduce arc flash risk.

Low voltage equipment

Arc flash risk is often incorrectly only associated with high voltage equipment. Arc flash energy levels can be higher on low voltage systems due to the longer fault clearing times associated with clearing high prospective energy level faults.



'Danger' arc flash labelling observed on facility low voltage switchboard

The legislation

Clause 9 (1) of Schedule 3 of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* places specific duties on the operator of a facility to take all reasonably practicable steps to ensure that:

- the facility is safe and without risk to the health of any person at or near the facility; and
- all work and other activities carried out on the facility are carried out in a manner that is safe and without risk to the health of any person at or near the facility.

Advice to operators

Operators of offshore petroleum facilities are required to ensure all electrical work and activities carried out on the facility are carried out in a manner that is safe and without risk to the health, which includes ensuring arc flash hazards are identified and associated risks are effectively managed.



By adopting and implementing controls, systems and practices from recognised industry accepted standards, such as recognised arc flash management guidance, the operator can reduce the risk of potential arc flash injury to personnel.

NOPSEMA inspection scopes may include arc flash management for selected facilities to ensure controls, systems and practices are effective and the workforce are safe.

Safety bulletins

The American Bureau of Safety and Environmental Enforcement recently issued a safety bulletin in 2019 on *Multiple Arc Flash Incidents on Offshore Facilities*:

<https://www.bsee.gov/sites/bsee.gov/files/safety-bulletins/bsee-safety-bulletin-021.pdf>

The Department of Mines and Petroleum WA issued a safety bulletin in 2016 on *Electrical Arc Flash Hazards in Mining*: https://www.dmp.wa.gov.au/Documents/Safety/MSH_SB_138.pdf

Additional resources

A suggested list of arc flash management good practice guidance is provided below:

Australian Energy Council, *Electrical Arc Flash Hazard Management Guideline*, March 2019

<https://www.energycouncil.com.au/news/electrical-arc-flash-hazard-guidelines-developed/>

Energy Institute, *Assessing and Managing the Risk of Arc Flash*, May 2018

https://publishing.energyinst.org/_data/assets/file/0006/534237/Sample-pages-Arc-flash-final.pdf

Australian Standards addressing safe isolation of electrical equipment include:

AS/NZS 4836:2011 Safe working on or near low-voltage electrical installations and equipment

AS 2467-2008 Maintenance of electrical switchgear

AS 2067:2016 Substations and high voltage installations exceeding 1 kV a.c.

Contact

Enquiries should be directed to communications@nopsema.gov.au and quote 'Safety bulletin – Electrical arc flash management'.